

APU Neural Net Tool (ANNT) Requirements

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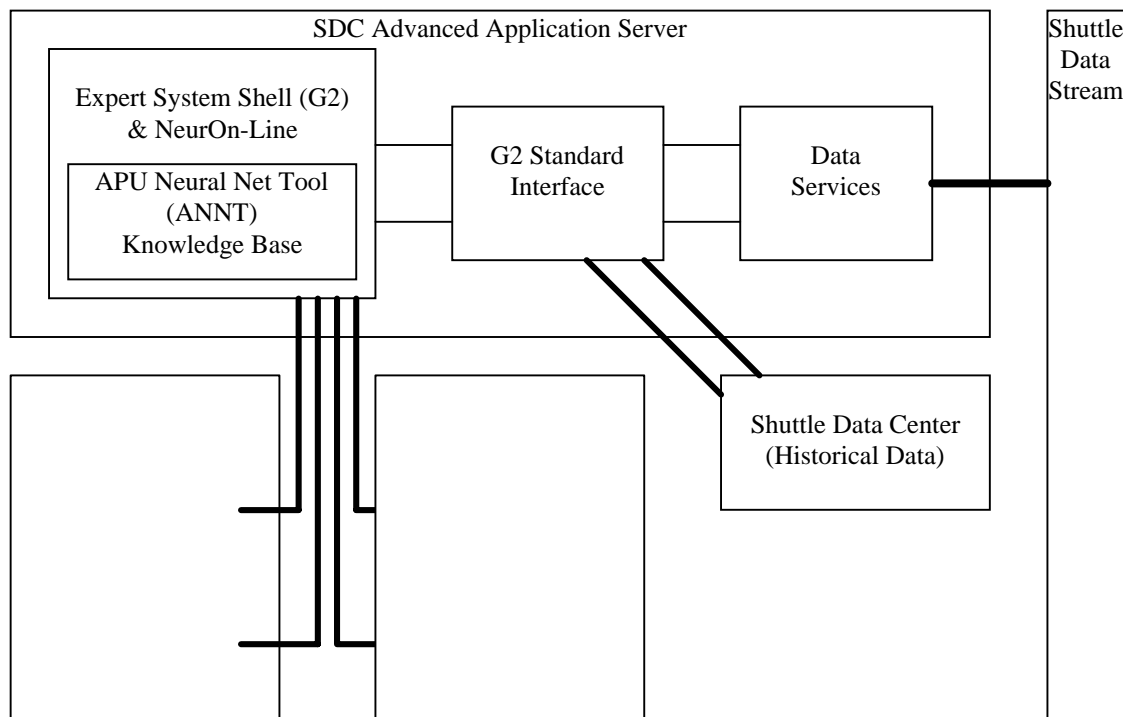
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APU Neural Net Tool

1.1 APU Neural Net Tool Introduction

1.1.1 APU Neural Net Tool Overview

The APU Neural Net Tool (ANNT) is an expert system software application that has been developed using Gensym's G2 and NeurOn-Line software. The tool combines a real-time display, saved historical data, individual pulse diagnostics, and supported by expert system heuristics to ensure accurate results.



1.1.2 APU Neural Net Tool Operational Description

Three hundred point packets are passed through a GSI interface into G2. The data is split into three 100-point buffers. Initially, an algorithm detects the start-up of the APU. Once the start-up has been recognized, a wave detection algorithm is performed on the next 100-point buffer to extract the chamber pressure wave pulse. The wave pulse data-set is passed through the Neural Net, which classifies the data. Historical records of the classifications are archived. The history data is queried by the heuristic expert system algorithm for the last ten wave pulse classifications and verifies the gimbaling type or error mode that is occurring. This state is indicated through multi-color indicators on the real-time display.

1.2 APU Neural Net Tool Specifications

1.2.1 APU Neural Net Groundrules

- At least one Gensym G2 and NeurOn-Line license must be resident on the SDC Advanced Application Server.
- APU Engineers must supply APU flight data needed to train the neural nets.
- Finalized detail descriptions of the CLCS data services are required such that the GSI code can be written to access it.
- ANNT shall run on BASIS

- 1.2.2 APU Neural Net Functional Requirements

The functional requirements of the APU Neural Net Tool are the following:

1. Platform Independent Interface
2. GSI Development
3. Porting Existing Code
4. Real-Time Display
5. Pulse Diagnostic Window
6. Known Flight Error Conditions
7. Trained Neural Nets
8. Start-Up Algorithm
9. Wave-Detection Algorithm
10. Load/No-Load Detection Algorithm

1 A platform independent interface shall be developed for accessing the ANNT program.

- 1.1 The user shall access the ANNT program through a platform independent GUI.

2 A G2 Standard Interface (GSI) shall be developed for the ANNT program.

- 1.1 Real time data shall be interfaced to the GSI interface.
- 1.2 SDC archived data shall be interfaced to the GSI interface.

3 Existing APU Neural Net code shall be ported to the G2 environment.

- 1.1 Existing C code shall ported into the G2 environment.

4 ANNT shall provide a real-time display.

- 1.1 The real time display shall provide all three APU outputs.
- 1.2 The display shall have colored indicators designating the state of each APU.

5 ANNT shall provide a pulse diagnostic window display.

- 1.1 A pulse diagnostic window shall be implemented to view individual waveshapes.

6 The ANNT knowledge base shall contain a data base of known flight error conditions.

- 1.1 Known flight anomalies shall be trained into the knowledge base.

7 The following ANNT Neural Nets shall be trained:

- 1.1 A neural net for Nominal waveshape recognition shall be trained.
- 1.2 A neural net for Aero Gimbaling waveshape recognition shall be trained.
- 1.3 A neural net for Engine Gimbaling waveshape recognition shall be trained.
- 1.4 A neural net for Broken Valve waveshape recognition shall be trained.
- 1.5 A neural net for waveshape Bubbling Effect recognition shall be trained.

8 A start-up algorithm shall be designed.

- 1.1 The start-up algorithm shall notify the user that APU start-up has occurred.

9 A wave-detection algorithm shall be designed.

- 1.1 The wave-detection algorithm shall recognize each individual waveshape.
- 1.2 The wave-detection algorithm shall window out and vectorize each waveshape.

10 A heuristic algorithm shall be designed.

- 1.1 The heuristic algorithm shall detect three loaded waveshapes as an Aero Gimballed waveshape.
- 1.2 The heuristic algorithm shall detect five loaded waveshapes as an Engine Gimballed waveshape.

1.2.3 APU Neural Net Tool Performance Requirements

- 1 Real-time data is required to arrive into G2/ANNT with less than a 400 millisecond delay.
- 2 Real-time display and neural net classification must occur in less than a 600 millisecond delay.

1.2.4 APU Neural Net Tool Interface Data Flow Diagrams

When G2/ANNT starts up, it sends a list of FDs to the GSI. The GSI sends the FD list to data services for validation. Every cycle (one second) the GSI sends the current value of FDs into G2. G2 knowledge base accepts the data and processes it for that cycle.

ANNT Data Flow Diagram

